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Mark Watson — Mark Watson
By — Signature

Application No.	**:**	**10/606,002**
Confirmation No.	**:**	**5988**
Applicant	**:**	**Cormac Herley**
Title	**:**	**SYSTEM AND METHOD FOR DE-NOISING MULTIPLE COPIES OF A SIGNAL**
Filed	**:**	**June 24, 2003**
TC/A.U.	**:**	**2624**
Examiner	**:**	**YUAN, Kathleen S.**
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Customer No.	**:**	**27662**

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

I. REAL PARTY IN INTEREST

The subject application is assigned to Microsoft Corporation, of Redmond Washington.

II. RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

III. STATUS OF CLAIMS

1. Claims 1 through 28 represent all claims currently pending in the application.

2. Claims 1 through 28 are rejected.

3. The rejection of claims 1 through 28 is hereby appealed.

IV. STATUS OF AMENDMENTS

An amendment to claims 1, 12, and 21 was submitted by Appellant on July 5, 2007 in response to the Final Office Action dated May 14, 2007. In accordance with the Advisory Action dated July 20, 2007, the amendment of July 5, 2007 was ***not*** entered by the Examiner. Consequently, for purposes of Appeal, claims 1-28 are in the form presented in the amendment filed by the Appellant on February 27, 2007 in response to the first Office Action issued in this case. These claims are presented in the attached Claims Appendix. No other amendments are currently pending.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The pending patent application includes three independent claims: claims 1, 12, and 21. A summary of the subject matter claimed in each independent claim is provided below:

a. <u>Subject Matter of Independent Claim 1:</u>

In general, the subject matter of claim 1 relates to a technique for automatically constructing an image mosaic from a set of images of a scene by replacing occluded regions in an image with corresponding non-occluded regions from other images.

As defined in claim 1, the claimed computer executable instructions generally begin operation by "inputting a set of images of a scene," such as, for example, image frame 400 and 410, as illustrated by FIG. 4A and FIG. 4B, respectively. See also element 200 of FIG. 2, which provides an image input module for receiving image frames of a scene either from one or more cameras (205) or from a database or directory of images (210).

Once these images have been received, the claimed computer executable instructions continue by "registering the set of images" (see also the image registration module 215 of FIG. 2). As is generally well understood by those skilled in the art, image registration is a process wherein two or more images are rotated, scaled, warped, translated, etc., as necessary, so that the features between those images are aligned. This concept is described throughput the specification of the present application. For example, paragraph [0018] of the present application explains that the claimed computer executable instructions operate "… by first ***aligning or registering*** a set of two or more images of a scene. During alignment of the images, conventional image registration techniques, including, for example, translation, rotation, scaling, and perspective warping of the images are used to align the images…"

Next, the claimed computer executable instructions operate to compare "the set of images to identify ***areas of difference*** between the images for all images, said areas of difference representing ***regions of potential occlusion*** in each image." In other words, given the set of registered images, those images are examined to identify areas of each image that differ from one image to the next. Any areas in one image that are different than corresponding areas in any other images are identified as corresponding

to “regions of potential occlusion.” It should be noted here that by identifying any region in a particular image as being a region of potential occlusion, all corresponding regions in all other images in the set of registered images are also identified as corresponding regions of potential occlusion. See for example, element 260 of FIG. 2, which provides an “image comparison module” that compares aligned images to identify areas of difference between those images.

Note that the concept of “occlusion” in images is generally well understood by those skilled in the art as referring to regions of an image that are obscured from view. For example, as described in paragraph [0056] of the present application (US Patent Application No. 2004-0264806 A1), “one might have several images of a famous monument, but be unable to capture an image of the scene which does not have one or more areas of occlusion due to people wandering in and out of the image frame.” This example is further illustrated by FIG. 4A and FIG. 4B, which illustrate a pictorial representation of a sequence of two image frames having areas of occlusions. For example, as described in paragraph [0107] of the present application, as “illustrated by FIG. 4A, image frame 400 illustrates an arch 420 that is partially occluded by two people 430. Similarly, as illustrated by FIG. 4B, image frame 410 illustrates the arch 420, with a background of the image frame being partially occluded by a third person 440.”

At this point in the claimed technique, there is a set of aligned or registered images having corresponding regions of potential occlusion. However, while a region of potential occlusion in one image may represent an actual region of occlusion relative to the scene, that same region in another of the images may correspond to a non-occluded region of the same scene. Consequently, the next step performed by the claimed computer executable instructions is to examine each of the potential regions of occlusion in each image to determine whether those potentially occluded regions are actually occluded or not.

In particular, the claimed computer executable instructions operate to determine, “for each image, whether regions of potential occlusion in each image represent ***actual***

regions of occlusion, or whether the regions of potential occlusion in each image represent ***regions of non-occlusion***, by determining a ***level of discontinuity along an exterior border of each region*** of potential occlusion in each image." In other words, having identified potential regions of occlusion for all images, the exterior borders of those regions are then examined to determine a level of discontinuity along those borders. The level of discontinuity determined for each particular border is then used in determining whether each of the corresponding regions is an actual region of occlusion or not. See for example, element 270 of FIG. 2, which provides a "discontinuity detection module" that compares "levels of discontinuity in two or more images for a particular potentially occluded region. Then, the image having a larger amount of discontinuity along the border of the potentially occluded region is identified as the image containing the occlusion" (see paragraph [0067] of the present application).

Finally, having made a determination as to which regions in each image are ***areas of actual occlusion*** and which areas of each image are ***non-occluded regions***, the claimed computer executable instructions operates to create a mosaic image "by replacing at least one actual region of occlusion in one image from the set of images with corresponding regions of non-occlusion from at least one other image from the set of images of the scene."

A simple graphical illustration of the technique defined by claim 1 is illustrated by the sequence of images shown in FIG. 4A through FIG. 9, as discussed in paragraphs [0106] through [0110] of the present application. In particular, these figures, in combination with paragraphs [0106] through [0110], which show a non-occluded mosaic image (FIG. 9) being constructed from two input images (400 and 410 of FIG 4A and FIG. 4B, respectively), with a region of actual occlusion (440 of FIG. 4B) in one of the images (410 of FIG. 4B) being replaced by a corresponding region taken from the other image (400 of FIG. 4A).

b. Subject Matter of Independent Claim 12:

In general, the subject matter of claim 12 relates to a system for removing occlusions from a composite image formed from a set of images of a scene.

As defined by claim 12, the claimed system begins operation by acquiring a set of images of a scene. These images are then aligned relative to a base image selected from the set of images. As is generally well understood by those skilled in the art, image alignment is a process wherein two or more images are rotated, scaled, warped, translated, etc., as necessary, so that the features between those images are aligned or registered. This concept is described throughput the specification of the present application. For example, paragraph [0018] of the present application explains that the claimed computer executable instructions operate "… by first ***aligning or registering*** a set of two or more images of a scene. During alignment of the images, conventional image registration techniques, including, for example, translation, rotation, scaling, and perspective warping of the images are used to align the images…"

Next, the aligned images are examined to identify areas of potential occlusion in each of the aligned images. Note that the concept of "occlusion" in images is generally well understood by those skilled in the art as referring to regions of an image that are obscured from view. For example, as described in paragraph [0056] of the present application (US Patent Application No. 2004-0264806 A1), "one might have several images of a famous monument, but be unable to capture an image of the scene which does not have one or more areas of occlusion due to people wandering in and out of the image frame." This example is further illustrated by FIG. 4A and FIG. 4B, which illustrate a pictorial representation of a sequence of two image frames having areas of occlusions. For example, as described in paragraph [0107] of the present application, as "illustrated by FIG. 4A, image frame 400 illustrates an arch 420 that is partially occluded by two people 430. Similarly, as illustrated by FIG. 4B, image frame 410 illustrates the arch 420, with a background of the image frame being partially occluded by a third person 440."

Once the areas of potential occlusion in each image have been identified, the claimed system continues operation by selecting a one of the images from the set of images. This selected images is referred to as a "seed image" since it is later used a foundation from which the composite image is formed. In particular, given the selected seed image, the claimed system examines that seed image to determine "whether each ***area of potential occlusion*** in the seed image is an ***actual area of occlusion*** by examining each area of potential occlusion in the seed image ***to determine whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold***."

In other words, the outer edges of each area of potential occlusion in the seed image are examined to determine a level of discontinuity along those edges. If the level of discontinuity for any edge exceeds some predetermined threshold, than the corresponding area of potential occlusion is identified as an ***actual area of occlusion***. See for example, element 270 of FIG. 2, which provides a "discontinuity detection module" that examines "…the pixels close to the border of each potential area of occlusion to identify pixel color or intensity discontinuities perpendicular to those edges…" (see paragraph [0067] of the present application). Again, when the resulting level of discontinuity exceeds the predetermined threshold, the region is identified as an actual area of occlusion.

Finally, the claimed system operates by "replacing areas of actual occlusion in the seed image with corresponding non-occluded areas from one of the other images in the set to form a composite image from the seed image."

A simple graphical illustration of the system defined by claim 12 is illustrated by the sequence of images shown in FIG. 4A through FIG. 9, as discussed in paragraphs [0106] through [0110] of the present application. In particular, these figures, in combination with paragraphs [0106] through [0110], which show a non-occluded composite image (FIG. 9) being constructed from two input images (400 and 410 of FIG 4A and FIG. 4B, respectively), with an area of actual occlusion (440 of FIG. 4B) in a

"seed image" (410 of FIG. 4B) being replaced by a corresponding region taken from the other image (400 of FIG. 4A).

c. <u>Subject Matter of Independent Claim 21:</u>

In general, the subject matter of claim 21 relates to process for removing occlusions from a mosaic image created from a set of images of a scene.

As defined by claim 21, the claimed process begins operation by inputting a set of two or more images of a scene. These images are then aligned relative to a base image selected from the set of images. As is generally well understood by those skilled in the art, image alignment is a process wherein two or more images are rotated, scaled, warped, translated, etc., as necessary, so that the features between those images are aligned or registered. This concept is described throughput the specification of the present application. For example, paragraph [0018] of the present application explains that the claimed computer executable instructions operate "… by first ***aligning or registering*** a set of two or more images of a scene. During alignment of the images, conventional image registration techniques, including, for example, translation, rotation, scaling, and perspective warping of the images are used to align the images…"

Next, the aligned images are compared "to identify areas of potential occlusion in each of the aligned images." See for example, element 260 of FIG. 2, which provides an "image comparison module" that compares aligned images to identify areas of difference between those images. Note that the concept of "occlusion" in images is generally well understood by those skilled in the art as referring to regions of an image that are obscured from view. For example, as described in paragraph [0056] of the present application (US Patent Application No. 2004-0264806 A1), "one might have several images of a famous monument, but be unable to capture an image of the scene which does not have one or more areas of occlusion due to people wandering in and out of the image frame." This example is further illustrated by FIG. 4A and FIG. 4B, which illustrate a pictorial representation of a sequence of two image frames having

areas of occlusions. For example, as described in paragraph [0107] of the present application, as "illustrated by FIG. 4A, image frame 400 illustrates an arch 420 that is partially occluded by two people 430. Similarly, as illustrated by FIG. 4B, image frame 410 illustrates the arch 420, with a background of the image frame being partially occluded by a third person 440."

Once the areas of potential occlusion in each image have been identified, the claimed process continues operation by "***determining a level of discontinuity along an outer edge of each area of potential occlusion for each image***, said level of discontinuity indicating an area of actual occlusion where the level of discontinuity exceeds a predetermined discontinuity threshold, and said level of discontinuity indicating an area of non-occlusion where the level of discontinuity is less than the predetermined discontinuity threshold."

In other words, the outer edges of each area of potential occlusion of each image are examined to determine a level of discontinuity along those edges. If the level of discontinuity for any edge exceeds predetermined discontinuity threshold, than the corresponding area of potential occlusion is identified as an ***area of actual occlusion***. Conversely, if the level of discontinuity is less than the predetermined discontinuity threshold, than the corresponding area of potential occlusion is identified as an ***area of non-occlusion***. See for example, element 270 of FIG. 2, which provides a "discontinuity detection module" that examines "…the pixels close to the border of each potential area of occlusion to identify pixel color or intensity discontinuities perpendicular to those edges…" (see paragraph [0067] of the present application).

Next, once each of the areas of potential occlusion in each image are identified as either an ***area of actual occlusion*** or as an ***area of non-occlusion***, the claimed process constructs an image mask for each image that specifically identifies areas of actual occlusion and areas of non-occlusion in each image. See for example, elements 260 and 270 of FIG. 2, wherein the image comparison module (260) creates an initial image mask (265) that is subsequently updated by the discontinuity detection module

(270) when the areas of potential occlusion in each image are identified as either an area of actual occlusion or as an area of non-occlusion (see paragraph [0066] and [0067] of the present application).

Finally, the claimed process uses the image masks constructed for each image to create "a mosaic image by replacing areas of actual occlusion in one of the images with corresponding areas of non-occlusion from one of the other images.

A simple graphical illustration of the process defined by claim 21 is illustrated by the sequence of images shown in FIG. 4A through FIG. 9, as discussed in paragraphs [0106] through [0110] of the present application. In particular, these figures, in combination with paragraphs [0106] through [0110], which show a non-occluded mosaic image (FIG. 9) being constructed from two input images (400 and 410 of FIG 4A and FIG. 4B, respectively), with an area of actual occlusion (440 of FIG. 4B) in one image (410 of FIG. 4B) being replaced by a corresponding region taken from the other image (400 of FIG. 4A) as a function of an updated image mask (element 700 of FIG. 7) for image frame 410 of FIG. 4B.

VI. <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

a. Independent claim 12 stands rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent Application Publication No. 20020181762 to Silber (hereinafter "***Silber***").

b. Independent claim 1 stands rejected under 35 U.S.C. §103(a) as being unpatentable over ***Silber*** in view of U.S. Patent No. 6,366,316 to Parulski, et al. (hereinafter "***Parulski***").

c. Independent claim 21 stands rejected under 35 U.S.C. §103(a) as being unpatentable over ***Silber*** in view of ***Parulski***.

VII. ARGUMENT

a. Rejection of Claim 12 under 35 U.S.C. §102(e):

Independent claim 12 was rejected under 35 U.S.C. §102(e), as being anticipated by U.S. Patent Application Publication No. 20020181762 to Silber (hereinafter "***Silber***"). In view of the following discussion, the Appellant will show that one or more elements of the Appellant's claimed system are not disclosed by the cited art, and that the Appellants claimed system is therefore patentable over that cited art.

In general, the Office Action rejected independent claim 12 under 35 USC §102(e) based on the rationale that the ***Silber*** reference teaches the Appellants' claimed "… system for removing occlusions from a composite image formed from a set of images of a scene…"

In particular, with respect to the issue of "***occlusions***," the Office Action suggests that the ***Silber*** reference discloses "identifying areas of potential occlusions in each of the aligned images…" However, Appellant believes that the Office Action has misinterpreted the capabilities and features of the ***Silber*** reference with respect to these alleged occlusion identification capabilities.

Specifically, as is well known to those skilled in the art, an occlusion in an image occurs when an object in an image frame of a particular scene covers or occludes all or part of another object in that image frame. In other words, an occlusion in an image exists when a region or area of a scene is hidden from view or otherwise covered from view by means of some intervening entity or object relative to a viewpoint from which an image of the scene is captured. More simply, the well understood concept of an occlusion in an image can be characterized as a region in an image that is obscured from view. The specification of the present application specifically defines this idea and is wholly consistent with the conventional interpretation of the term "occlusion" as recited above.

For example, as described in paragraph [0056] of the present application (US Patent Application No. 2004-0264806 A1), “one might have several images of a famous monument, but be unable to capture an image of the scene which does not have one or more areas of ***occlusion*** due to people wandering in and out of the image frame.” This example is further illustrated by FIG. 4A and FIG. 4B, which illustrate a pictorial representation of a sequence of two image frames having areas of occlusions. Specifically, as described in paragraph [0107] of the present application, as “illustrated by FIG. 4A, image frame 400 illustrates an arch 420 that is partially ***occluded*** by two people 430. Similarly, as illustrated by FIG. 4B, image frame 410 illustrates the arch 420, with a background of the image frame being partially ***occluded*** by a third person 440.”

In contrast to the clear definitions and drawings provided in the present application, the Examiner has suggested that the interpretation of the term “occlusion” offered by the Appellant is only “one interpretation of the word occlusion…” and that if “the applicant intends to further define the region of occlusion to mean an area in which an object covers another object, the applicant is invited to do so.” In response, the Appellant did in fact attempt to amend the claim to recite: “***wherein an occlusion represents an area in any of the images that is at least partially obstructed from view by one or more objects***…” However, in the Advisory Action, the Examiner responded by refusing to enter the above-quoted amendment and suggesting that the “applicant has amended the claims to encompass a different scope and thus would require further consideration and search.”

In view of both the Final Office Action and in view of the Advisory Action, it should be clear that the Examiner is interpreting the term “occlusion” in a manner that is in direct conflict with the commonly understood meaning of occlusions as specifically defined and graphically illustrated in the present specification. Specifically, the Examiner has insisted on redefining the term “occlusion” in a manner that is wholly inconsistent with both the present specification and drawings, and with the common

usage of occlusions in the art of image processing as it is generally understood to those skilled in the art.

In fact, in paragraph 7 of the Final Office Action dated May 14, 2007, the Examiner states: "***The examiner agrees that Silber does not completely provide a technique for deciding whether a particular edge represents the boundary of an object that is occluding some portion of the scene***…" As such, the meaning of the term "occlusion" as specifically defined by the Appellant in the specification of the present application and as clearly illustrated by the Appellant in the drawings of the present application is of primary concern in this Appeal.

Specifically, in the Final Office Action, the Examiner argues:

> "… One of the definitions of "occlusion" is "the process of occluding," according to dictionary.com, where "occlude" means "to obstruct", or "to prevent the passage of." Any region that is masked or not used in further processing is an occluded region since the region is obstructed from further processing. The region that is not masked is used in further processing can also be interpreted as occluded, because it is occluded by the mask…"

The Examiner then uses the circular logic of the above quoted argument in an attempt to explain that the ***Silber*** reference completely discloses the claimed elements of "***identifying areas of potential occlusion in each of the aligned images***…" and "***determining whether each area of potential occlusion in the seed image is an actual area of occlusion*** by examining each area of potential occlusion in the seed image to ***determine whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold***…"

In particular, the Examiner argues that in FIG. 5, step 730, and in paragraph [0089], ***Silber*** teaches "determining whether each area of potential occlusion in the

seed image is an actual area of occlusion by examining each area of potential occlusion in the seed image to determine whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold." Specifically, in the Office Action, dated December 13, 2006, the Examiner stated that this feature of the Appellant's claimed system is taught by ***Silber*** "***since the amount of focus of the line, which is equivalent to discontinuous because it is not a solid, clear line, is compared to a threshold***..." (emphasis added). The Examiner then further clarified this position in the Final Office Action dated May 14, 2007 by arguing the following:

> "***By determining whether a particular edge represents a best level focus*** for that edge, the edge is "highlighted" so to speak as a good area to represent the composite image. Therefore, ***a determination of a region of occlusion is accomplished by the evaluation of detected edges since the detected edges are evaluated***, and a ***region is determined as occluded since certain areas are not further processed***, the areas that are not of the valid edge, and thus occluded from further processing." (emphasis added)

However, in contrast to the position argued by the Examiner, Appellant respectfully suggests that ***Silber*** does not disclose the elements suggested by the Office Action, ***regardless of how the term "occlusion" is interpreted***. For example, as described by ***Silber*** in the Abstract, in independent claims 1, 20, 21 and 22, and throughout the specification with respect to Figures 1-13, ***Silber*** is directed towards compositing images of single objects or "workpieces" in the case where each of the multiple images of the single objects is captured at a ***different depth of focus***. In fact, ***Silber*** makes use of different depths of focus, ***in every disclosed and claimed embodiment***, in order to capture 3D details of the single workpiece such that each feature of the single workpiece is captured at various levels of focus. The ***edges of each image are then examined to select those edges that are in best focus***, with the ***best focused edges then being used to construct a composite image of the single workpiece***. Clearly, ***Silber*** discloses a process for evaluating edge focus levels

to determine whether an edge is ***adequately focused*** in view of some ***predetermined focus threshold*** (e.g., the "numerical threshold value" described by ***Silber***).

For example, in paragraph [0016], ***Silber*** specifically summarizes his invention as follows:

> "[0016] This invention separately provides systems and methods that ***construct a desirable composite image while <u>suppressing likely artifacts arising from out-of-focus features</u>***."

Further, in paragraph [0089], as cited by the Office Action with respect to Figure 3, ***Silber*** teaches the following:

> "[0089] In step S730, a *determination is made whether the selected source image analysis result is* ***indicative of a valid edge***. For example, if the source image analysis result is a ***numerical edge-focus indicator*** result, this result is ***compared to a numerical threshold value***, where only ***values exceeding the threshold value are taken to be indicative of a valid and <u>adequately-focused edge</u> for purposes of constructing the composite image***. If the source image analysis result is not indicative of a valid edge, then operation returns to step S715. Otherwise, operation continues to step S735." (emphasis added)

Clearly, the focus-based edge detection process disclosed by Silber fails completely to provide a technique for first "***identifying areas of potential occlusion***…" and then ***determining*** whether each of those areas of potential occlusion is "***an actual area of occlusion***…" based on "***whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold***…"

In fact, the invention described by ***Silber*** is specifically directed towards constructing a composite image from multiple images of a single object or workpiece

based solely ***on which edges are in best focus***. Consequently, Appellant respectfully suggests that any composite image created by the ***Silber*** invention from a set of images that include ***one or more actual areas of occlusion*** would tend to ***<u>include portions of both occluding objects and non-occluded regions of images as a function of edge focus levels</u>*** rather than whether or not an area was actually occluded. In fact, Appellant believes that the edges of occluding objects would be ***favored*** by the ***Silber*** system since the edges of any occluding object in a particular image frame would necessarily be in better focus than any edges that are actually occluded and would therefore not even be visible.

Clearly, ***Silber*** fails completely to provide any technique whatsoever for making a determination as to whether an area of an image is occluded, and then to selectively replace any occluded areas with corresponding non-occluded regions from other images. Therefore, in view of the preceding discussion, it is clear that the present system, as claimed by independent claim 12 has elements not disclosed in the ***Silber*** reference. Consequently, the rejection of claim 12 under 35 U.S.C. §102(e) is not proper. Therefore, the Appellants respectfully traverse the rejection of claim 12 under 35 U.S.C. §102(e) in view of the novel language of claim 12. In particular, claim 12 recites the following novel language:

> "A system for removing occlusions from a composite image formed from a set of images of a scene, comprising:
>
> acquiring at least two images of a scene from approximately the same viewpoint;
>
> aligning each of the images to a base image selected from the set of images;
>
> ***identifying areas of potential occlusion in each of the aligned images***;
>
> selecting a seed image from the set of images;
>
> ***determining whether each area of potential occlusion in the seed image is an actual area of occlusion*** by examining each area of

> potential occlusion in the seed image to ***determine whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold***;
>
> ***replacing areas of actual occlusion*** in the seed image with corresponding ***non-occluded areas from one of the other images*** in the set to form a composite image from the seed image." (emphasis added)

b. <u>Rejection of Claim 1 under 35 U.S.C. §103(a):</u>

Independent claim 1 was rejected under 35 U.S.C. §103(a) as being unpatentable over ***Silber*** in view of U.S. Patent No. 6,366,316 to Parulski, et al. (hereinafter "***Parulski***").

In general, in the Final Office Action dated May 14, 2007, the Examiner rejected independent claim 1 under 35 USC §103(a) based on the rationale that the ***Silber*** reference discloses the claimed computer executable instructions with the exception of "comparing the set of images to identify areas of difference between the images for all images, said areas of difference representing regions of potential occlusion in each image." The Office Action then continues by suggesting that this feature lacking in the ***Silber*** reference is disclosed by the ***Parulski*** reference. Further, Examiner specifically explains the functionality of the proposed ***Silber-Parulski*** combination reference as follows:

> "First, the proposed Silber-Parulski combination will receive two images, and then the second image will be subtracted from the first image to provide a single image of a 'subject,' representing a region of occlusion. ***This first step represents the Parulski contribution to the proposed Silber-Parulski combination***. Next, the proposed Silber-Parulski combination will ***<u>determine whether the regions of potential occlusion represent actual regions of occlusion by examining edges, as the prior art and prior rejection have stated, as having a valid focus</u>***. If it

> does then a mosaic image is made with the two images by combining images." (emphasis added)

Clearly, the Examiner has explained that the ***Parulski*** contribution to the proposed combination reference is limited to receiving "two images, and then the second image will be subtracted from the first image to provide a single image of a 'subject,' representing a region of occlusion…" As such, one important issue is whether the ***Silber*** reference discloses the claimed elements pertaining to identification of regions of potential occlusion followed by a determination of whether each region potential occlusion is an actual region of occlusion or is a region of non-occlusion by determining a level of discontinuity along an exterior border of each region of potential occlusion.

Thus, with respect to the issue of "***occlusions***," the Office Action suggests that the ***Silber*** reference discloses "determining, for each image, ***whether regions of potential occlusion in each image represent actual regions of occlusion***, or whether the regions of potential occlusion in each image represent regions of non-occlusion, ***by determining a level of discontinuity along an exterior border of each region of potential occlusion in each image*** (fig. 5, step 730, as explained above)…" (emphasis added). However, Appellant believes that the Office Action has misinterpreted the capabilities and features of the ***Silber*** reference with respect to these alleged occlusion identification capabilities.

Specifically, as is well known to those skilled in the art, an occlusion in an image occurs when an object in an image frame of a particular scene covers or occludes all or part of another object in that image frame. In other words, an occlusion in an image exists when a region or area of a scene is hidden from view or otherwise covered from view by means of some intervening entity or object relative to a viewpoint from which an image of the scene is captured. More simply, the well understood concept of an occlusion in an image can be characterized as a region in an image that is obscured from view. The specification of the present application specifically defines this idea and

is wholly consistent with the conventional interpretation of the term “occlusion” as recited above.

For example, as described in paragraph [0056] of the present application (US Patent Application No. 2004-0264806 A1), “one might have several images of a famous monument, but be unable to capture an image of the scene which does not have one or more areas of ***occlusion*** due to people wandering in and out of the image frame.” This example is further illustrated by FIG. 4A and FIG. 4B, which illustrate a pictorial representation of a sequence of two image frames having areas of occlusions. Specifically, as described in paragraph [0107] of the present application, as “illustrated by FIG. 4A, image frame 400 illustrates an arch 420 that is partially ***occluded*** by two people 430. Similarly, as illustrated by FIG. 4B, image frame 410 illustrates the arch 420, with a background of the image frame being partially ***occluded*** by a third person 440.”

In contrast to the clear definitions and drawings provided in the present application in the Final Office Action, the Examiner suggested that the interpretation of the term “occlusion” offered by the Appellant is only “one interpretation of the word occlusion…” and that if “the applicant intends to further define the region of occlusion to mean an area in which an object covers another object, the applicant is invited to do so.” In response, the Appellant did in fact attempt to amend the claim to recite: “***wherein an occlusion represents an area in any of the images that is at least partially obstructed from view by one or more objects***…” However, in the Advisory Action, the Examiner responded by refusing to enter the above-quoted amendment and suggesting that the “applicant has amended the claims to encompass a different scope and thus would require further consideration and search.”

In view of both the Final Office Action and in view of the Advisory Action, it should be clear that the Examiner is interpreting the term “occlusion” in a manner that is in direct conflict with the commonly understood meaning of occlusions as specifically defined and graphically illustrated in the present specification. Specifically, the

Examiner has insisted on redefining the term "occlusion" in a manner that is wholly inconsistent with both the present specification and drawings, and with the common usage of occlusions in the art of image processing as it is generally understood to those skilled in the art.

In fact, in paragraph 7 of the Final Office Action dated May 14, 2007, the Examiner states: "***The examiner agrees that Silber does not completely provide a technique for deciding whether a particular edge represents the boundary of an object that is occluding some portion of the scene***…" As such, the meaning of the term "occlusion" as specifically defined by the Appellant in the specification of the present application and as clearly illustrated by the Appellant in the drawings of the present application is of primary concern in this Appeal.

Specifically, in the Final Office Action, the Examiner argues:

> "… One of the definitions of "occlusion" is "the process of occluding," according to dictionary.com, where "occlude" means "to obstruct", or "to prevent the passage of." Any region that is masked or not used in further processing is an occluded region since the region is obstructed from further processing. The region that is not masked is used in further processing can also be interpreted as occluded, because it is occluded by the mask…"

The Examiner then uses the circular logic of the above quoted argument in an attempt to explain that the ***Silber*** reference completely discloses the claimed element of "***determining***, for each image, ***whether regions of potential occlusion*** in each image ***represent actual regions of occlusion, or*** whether the regions of potential occlusion in each image represent ***regions of non-occlusion***, ***by determining a level of discontinuity along an exterior border of each region of potential occlusion*** in each image…"

In particular, the Examiner argues that in FIG. 5, step 730, and in paragraph [0089], ***Silber*** teaches "determining whether each area of potential occlusion in the seed image is an actual area of occlusion by examining each area of potential occlusion in the seed image to determine whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold." Specifically, in the Office Action, dated December 13, 2006, the Examiner stated that this feature of the Appellant's claimed system is taught by ***Silber*** "***since the amount of focus of the line, which is equivalent to discontinuous because it is not a solid, clear line, is compared to a threshold***..." (emphasis added). The Examiner then further clarified this position in the Final Office Action dated May 14, 2007 by arguing the following:

> "***By determining whether a particular edge represents a best level focus*** for that edge, the edge is "highlighted" so to speak as a good area to represent the composite image. Therefore, ***a determination of a region of occlusion is accomplished by the evaluation of detected edges since the detected edges are evaluated***, and a ***region is determined as occluded since certain areas are not further processed***, the areas that are not of the valid edge, and thus occluded from further processing." (emphasis added)

However, in contrast to the position argued by the Examiner, Appellant respectfully suggests that ***Silber*** does not disclose the elements suggested by the Office Action, <u>***regardless of how the term "occlusion" is interpreted***</u>. For example, as described by ***Silber*** in the Abstract, in independent claims 1, 20, 21 and 22, and throughout the specification with respect to Figures 1-13, ***Silber*** is directed towards compositing images of single objects or "workpieces" in the case where each of the multiple images of the single objects is captured at a ***different depth of focus***. In fact, ***Silber*** makes use of different depths of focus, ***in every disclosed and claimed embodiment***, in order to capture 3D details of the single workpiece such that each feature of the single workpiece is captured at various levels of focus. The ***edges of each image are then examined to select those edges that are in best focus***, with

the ***best focused edges then being used to construct a composite image of the single workpiece***. Clearly, ***Silber*** discloses a process for evaluating edge focus levels to determine whether an edge is ***adequately focused*** in view of some ***predetermined focus threshold*** (e.g., the "numerical threshold value" described by ***Silber***).

For example, in paragraph [0016], ***Silber*** specifically summarizes his invention as follows:

> "[0016] This invention separately provides systems and methods that ***construct a desirable composite image while <u>suppressing likely artifacts arising from out-of-focus features</u>***."

Further, in paragraph [0089], as cited by the Office Action with respect to Figure 3, ***Silber*** teaches the following:

> "[0089] In step S730, a *determination is made whether the selected source image analysis result is* ***indicative of a valid edge***. For example, if the source image analysis result is a ***numerical edge-focus indicator*** result, this result is ***compared to a numerical threshold value***, where only ***values exceeding the threshold value are taken to be indicative of a valid and <u>adequately-focused edge</u> for purposes of constructing the composite image***. If the source image analysis result is not indicative of a valid edge, then operation returns to step S715. Otherwise, operation continues to step S735." (emphasis added)

Clearly, the focus-based edge detection process disclosed by Silber fails completely to provide a technique for "determining… whether regions of potential occlusion… represent actual regions of occlusion… or … regions of non-occlusion, by determining a level of discontinuity along an exterior border of each region of potential occlusion…" as disclosed and claimed by the Appellant.

In fact, the invention described by ***Silber*** is specifically directed towards constructing a composite image from multiple images of a single object or workpiece based solely ***on which edges are in best focus***. Consequently, Appellant respectfully suggests that any composite image created by the ***Silber*** invention from a set of images that include ***one or more actual areas of occlusion*** would tend to ***include portions of both occluding objects and non-occluded regions of images as a function of edge focus levels*** rather than whether or not an area was actually occluded. In fact, Appellant believes that the edges of occluding objects would be ***favored*** by the ***Silber*** system since the edges of any occluding object in a particular image frame would necessarily be in better focus than any edges that are actually occluded and would therefore not even be visible.

Clearly, the proposed ***Silber- Parulski*** combination reference fails completely to provide any technique whatsoever for comparing images to identify areas of difference representing regions of potential occlusion in each image and then determining a level of discontinuity along an exterior border of each region of potential occlusion to determine whether each region represents an actual region of occlusion for use in creating a mosaic image by replacing actual region of occlusions with corresponding regions of non-occlusion from other images as disclosed and claimed by the Appellant. Therefore, in view of the preceding discussion, it is clear that the present system, as claimed by independent claim 1 has elements not disclosed in the proposed ***Silber-Parulski*** combination reference. Consequently, the rejection of claim 1 under 35 U.S.C. §103(a) is not proper. Therefore, the Appellants respectfully traverse the rejection of claim 1 under 35 U.S.C. §103(a) in view of the novel language of claim 1. In particular, claim 1 recites the following novel language:

> "A physical computer-readable medium having stored thereon computer executable instructions for automatically constructing an image mosaic from a set of images of a scene, said computer executable instructions comprising:
>
> inputting a set of images of a scene;

> registering the set of images;
>
> ***comparing the set of images to identify*** areas of difference between the images for all images, said areas of difference representing ***regions of potential occlusion in each image***;
>
> ***determining***, for each image, ***whether regions of potential occlusion*** in each image ***represent actual regions of occlusion***, or whether the regions of potential occlusion in each image represent regions of non-occlusion, ***by determining a level of discontinuity along an exterior border of each region of potential occlusion*** in each image; and
>
> creating a mosaic image by ***replacing at least one actual region of occlusion in one image from the set of images with corresponding regions of non-occlusion*** from at least one other image from the set of images of the scene." (emphasis added)

c. <u>Rejection of Claim 21 under 35 U.S.C. §103(a):</u>

Independent claim 21 was rejected under 35 U.S.C. §103(a) as being unpatentable over ***Silber*** in view of U.S. Patent No. 6,366,316 to Parulski, et al. (hereinafter "***Parulski***").

In general, in the Final Office Action dated May 14, 2007, the Examiner rejected independent claim 21 under 35 USC §103(a) based on the rationale that the ***Silber*** reference discloses the claimed process when combined with the ***Parulski*** reference. Further, Examiner specifically explains the functionality of the proposed ***Silber-Parulski*** combination reference as follows:

> "First, the proposed Silber-Parulski combination will receive two images, and then the second image will be subtracted from the first image to provide a single image of a 'subject,' representing a region of occlusion. ***This first step represents the Parulski contribution to the proposed***

> ***Silber-Parulski combination***. Next, the proposed Silber-Parulski combination will ***<u>determine whether the regions of potential occlusion represent actual regions of occlusion by examining edges, as the prior art and prior rejection have stated, as having a valid focus</u>***. If it does then a mosaic image is made with the two images by combining images." (emphasis added)

Clearly, the Examiner has explained that the ***Parulski*** contribution to the proposed combination reference is limited to receiving "two images, and then the second image will be subtracted from the first image to provide a single image of a 'subject,' representing a region of occlusion…" As such, one important issue is whether the ***Silber*** reference discloses the claimed elements pertaining to ***determining areas of actual occlusion and areas of non-occlusion based on edge discontinuity levels determined for each area of potential occlusion***.

In particular, with respect to the issue of "***occlusions***," the Office Action suggests that the ***Silber*** reference discloses "***determining a level of discontinuity along an outer edge of each area of potential occlusion*** for each image, said ***level of discontinuity indicating an area of actual occlusion where the level of discontinuity exceeds a predetermined discontinuity threshold***, and said ***level of discontinuity indicating an area of non-occlusion where the level of discontinuity is less than the predetermined discontinuity threshold*** (fig. 5, s730, and as explained above)…" (emphasis added). However, Appellant believes that the Office Action has misinterpreted the capabilities and features of the ***Silber*** reference with respect to these alleged occlusion identification capabilities.

Specifically, as is well known to those skilled in the art, an occlusion in an image occurs when an object in an image frame of a particular scene covers or occludes all or part of another object in that image frame. In other words, an occlusion in an image exists when a region or area of a scene is hidden from view or otherwise covered from view by means of some intervening entity or object relative to a viewpoint from which an

image of the scene is captured. More simply, the well understood concept of an occlusion in an image can be characterized as a region in an image that is obscured from view. The specification of the present application specifically defines this idea and is wholly consistent with the conventional interpretation of the term "occlusion" as recited above.

For example, as described in paragraph [0056] of the present application (US Patent Application No. 2004-0264806 A1), "one might have several images of a famous monument, but be unable to capture an image of the scene which does not have one or more areas of ***occlusion*** due to people wandering in and out of the image frame." This example is further illustrated by FIG. 4A and FIG. 4B, which illustrate a pictorial representation of a sequence of two image frames having areas of occlusions. Specifically, as described in paragraph [0107] of the present application, as "illustrated by FIG. 4A, image frame 400 illustrates an arch 420 that is partially ***occluded*** by two people 430. Similarly, as illustrated by FIG. 4B, image frame 410 illustrates the arch 420, with a background of the image frame being partially ***occluded*** by a third person 440."

In contrast to the clear definitions and drawings provided in the present application, the Examiner has suggested that the interpretation of the term "occlusion" offered by the Appellant is only "one interpretation of the word occlusion…" and that if "the applicant intends to further define the region of occlusion to mean an area in which an object covers another object, the applicant is invited to do so." In response, the Appellant did in fact attempt to amend the claim to recite: "***wherein an occlusion represents an area in any of the images that is at least partially obstructed from view by one or more objects***…" However, in the Advisory Action, the Examiner responded by refusing to enter the above-quoted amendment and suggesting that the "applicant has amended the claims to encompass a different scope and thus would require further consideration and search."

In view of both the Final Office Action and in view of the Advisory Action, it should be clear that the Examiner is interpreting the term "occlusion" in a manner that is in direct conflict with the commonly understood meaning of occlusions as specifically defined and graphically illustrated in the present specification. Specifically, the Examiner has insisted on redefining the term "occlusion" in a manner that is wholly inconsistent with both the present specification and drawings, and with the common usage of occlusions in the art of image processing as it is generally understood to those skilled in the art.

In fact, in paragraph 7 of the Final Office Action dated May 14, 2007, the Examiner states: "***The examiner agrees that Silber does not completely provide a technique for deciding whether a particular edge represents the boundary of an object that is occluding some portion of the scene***…" As such, the meaning of the term "occlusion" as specifically defined by the Appellant in the specification of the present application and as clearly illustrated by the Appellant in the drawings of the present application is of primary concern in this Appeal.

Specifically, in the Final Office Action, the Examiner argues:

> "… One of the definitions of "occlusion" is "the process of occluding," according to dictionary.com, where "occlude" means "to obstruct", or "to prevent the passage of." Any region that is masked or not used in further processing is an occluded region since the region is obstructed from further processing. The region that is not masked is used in further processing can also be interpreted as occluded, because it is occluded by the mask…"

The Examiner then uses the circular logic of the above quoted argument in an attempt to explain that the ***Silber*** reference completely discloses the claimed element of "***determining a level of discontinuity along an outer edge of each area of potential occlusion*** for each image, said ***level of discontinuity indicating an area of actual***

occlusion where the level of discontinuity exceeds a predetermined discontinuity threshold, and said ***level of discontinuity indicating an area of non-occlusion where the level of discontinuity is less than the predetermined discontinuity threshold***…"

In particular, the Examiner argues that in FIG. 5, step 730, and in paragraph [0089], ***Silber*** teaches "determining whether each area of potential occlusion in the seed image is an actual area of occlusion by examining each area of potential occlusion in the seed image to determine whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold." Specifically, in the Office Action, dated December 13, 2006, the Examiner stated that this feature of the Appellant's claimed system is taught by ***Silber*** "***since the amount of focus of the line, which is equivalent to discontinuous because it is not a solid, clear line, is compared to a threshold***…" (emphasis added). The Examiner then further clarified this position in the Final Office Action dated May 14, 2007 by arguing the following:

> "***By determining whether a particular edge represents a best level focus*** for that edge, the edge is "highlighted" so to speak as a good area to represent the composite image. Therefore, ***a determination of a region of occlusion is accomplished by the evaluation of detected edges since the detected edges are evaluated***, and a ***region is determined as occluded since certain areas are not further processed***, the areas that are not of the valid edge, and thus occluded from further processing." (emphasis added)

However, in contrast to the position argued by the Examiner, Appellant respectfully suggests that ***Silber*** does not disclose the elements suggested by the Office Action, ***<u>regardless of how the term "occlusion" is interpreted</u>***. For example, as described by ***Silber*** in the Abstract, in independent claims 1, 20, 21 and 22, and throughout the specification with respect to Figures 1-13, ***Silber*** is directed towards compositing images of single objects or "workpieces" in the case where each of the

multiple images of the single objects is captured at a ***different depth of focus***. In fact, ***Silber*** makes use of different depths of focus, ***in every disclosed and claimed embodiment***, in order to capture 3D details of the single workpiece such that each feature of the single workpiece is captured at various levels of focus. The ***edges of each image are then examined to select those edges that are in best focus***, with the ***best focused edges then being used to construct a composite image of the single workpiece***. Clearly, ***Silber*** discloses a process for evaluating edge focus levels to determine whether an edge is ***adequately focused*** in view of some ***predetermined focus threshold*** (e.g., the "numerical threshold value" described by ***Silber***).

For example, in paragraph [0016], ***Silber*** specifically summarizes his invention as follows:

> "[0016] This invention separately provides systems and methods that ***construct a desirable composite image while <u>suppressing likely artifacts arising from out-of-focus features</u>***."

Further, in paragraph [0089], as cited by the Office Action with respect to Figure 3, ***Silber*** teaches the following:

> "[0089] In step S730, a *determination is made whether the selected source image analysis result is* ***indicative of a valid edge***. For example, if the source image analysis result is a ***numerical edge-focus indicator*** result, this result is ***compared to a numerical threshold value***, where only ***values exceeding the threshold value are taken to be indicative of a valid and <u>adequately-focused edge</u> for purposes of constructing the composite image***. If the source image analysis result is not indicative of a valid edge, then operation returns to step S715. Otherwise, operation continues to step S735." (emphasis added)

Clearly, the focus-based edge detection process disclosed by Silber fails completely to provide a technique for "determining… whether regions of potential occlusion… represent actual regions of occlusion… or … regions of non-occlusion, by determining a level of discontinuity along an exterior border of each region of potential occlusion…" as disclosed and claimed by the Appellant.

In fact, the invention described by ***Silber*** is specifically directed towards constructing a composite image from multiple images of a single object or workpiece based solely ***on which edges are in best focus***. Consequently, Appellant respectfully suggests that any composite image created by the ***Silber*** invention from a set of images that include ***one or more actual areas of occlusion*** would tend to ***include portions of both occluding objects and non-occluded regions of images as a function of edge focus levels*** rather than whether or not an area was actually occluded. In fact, Appellant believes that the edges of occluding objects would be ***favored*** by the ***Silber*** system since the edges of any occluding object in a particular image frame would necessarily be in better focus than any edges that are actually occluded and would therefore not even be visible.

Clearly, the proposed ***Silber- Parulski*** combination reference fails completely to provide any technique whatsoever for determining a level of discontinuity along an outer edge of each area of potential occlusion for each image, said level of discontinuity indicating an area of actual occlusion where the level of discontinuity exceeds a predetermined discontinuity threshold, and said level of discontinuity indicating an area of non-occlusion where the level of discontinuity is less than the predetermined discontinuity threshold. Therefore, in view of the preceding discussion, it is clear that the present process, as claimed by independent claim 21 has elements not disclosed in the proposed ***Silber- Parulski*** combination reference. Consequently, the rejection of claim 21 under 35 U.S.C. §103(a) is not proper. Therefore, the Appellants respectfully traverse the rejection of claim 21 under 35 U.S.C. §103(a) in view of the novel language of claim 21. In particular, claim 21 recites the following novel language:

"A computer-implemented process for removing occlusions from a mosaic image created from a set of images of a scene, comprising:

inputting a set of two or more images of a scene;

aligning each of the images to a base image selected from the set of images;

comparing each of the aligned images to identify areas of potential occlusion in each of the aligned images;

determining a level of discontinuity along an outer edge of each area of potential occlusion for each image, said level of discontinuity indicating an area of actual occlusion where the level of discontinuity exceeds a predetermined discontinuity threshold, and said level of discontinuity indicating an area of non-occlusion where the level of discontinuity is less than the predetermined discontinuity threshold;

creating an image mask for each image, said image masks indicating areas of occlusion and areas of non-occlusion for each image; and

using the image mask for each image for creating a mosaic image by replacing areas of actual occlusion in one of the images with corresponding areas of non-occlusion from one of the other images." (emphasis added)

VIII. <u>CLAIMS APPENDIX</u>

The claims listed below provide a complete copy of all claims involved in the Appeal:

<u>Listing of Claims:</u>

1 (Previously Presented). A physical computer-readable medium having stored thereon computer executable instructions for automatically constructing an image

mosaic from a set of images of a scene, said computer executable instructions comprising:

inputting a set of images of a scene;

registering the set of images;

comparing the set of images to identify areas of difference between the images for all images, said areas of difference representing regions of potential occlusion in each image;

determining, for each image, whether regions of potential occlusion in each image represent actual regions of occlusion, or whether the regions of potential occlusion in each image represent regions of non-occlusion, by determining a level of discontinuity along an exterior border of each region of potential occlusion in each image; and

creating a mosaic image by replacing at least one actual region of occlusion in one image from the set of images with corresponding regions of non-occlusion from at least one other image from the set of images of the scene.

2 (Original). The computer-readable medium of claim 1 wherein registering the images comprises at least one of translating the images, rotating the images, scaling the images and warping the images, for aligning the images.

3 (Original). The computer-readable medium of claim 1 further comprising cropping the images after registering the set of images so that all images cover approximately the same view of the scene.

4 (Original). The computer-readable medium of claim 1 further comprising balancing the set of images.

5 (Original). The computer-readable medium of claim 4 wherein balancing the images comprises histogram averaging of the images based on corresponding targets for each image.

6 (Original). The computer-readable medium of claim 4 wherein balancing the images comprises white balancing the images based on corresponding targets for each image.

7 (Original). The computer-readable medium of claim 1 wherein comparing the set of images to identify areas of difference between the images for all images further comprises comparing corresponding blocks of image pixels between each image to determine whether the corresponding blocks match.

8 (Original). The computer-readable medium of claim 1 wherein comparing the set of images to identify areas of difference between the images for all images further comprises automatically constructing at least one image mask for identifying non-occluded regions and regions of potential occlusion in the set of images.

9 (Previously Presented). The computer-readable medium of claim 7 determining whether the corresponding blocks match further comprises determining whether the corresponding blocks match within a predetermined matching threshold.

10 (Original). The computer-readable medium of claim 1 wherein replacing at least one actual region of occlusion in one image from the set of images with corresponding regions of non-occlusion further comprises at least one of blending, feathering, and pixel averaging, along the edge of the corresponding regions of non-occlusion used to replace any actual regions of occlusion.

11 (Original). The computer-readable medium of claim 1 further comprising a user interface for excluding one or more actual regions of occlusion from being replaced with corresponding regions of non-occlusion.

12 (Original). A system for removing occlusions from a composite image formed from a set of images of a scene, comprising:

acquiring at least two images of a scene from approximately the same viewpoint;

aligning each of the images to a base image selected from the set of images;

identifying areas of potential occlusion in each of the aligned images;

selecting a seed image from the set of images;

determining whether each area of potential occlusion in the seed image is an actual area of occlusion by examining each area of potential occlusion in the seed image to determine whether a level of discontinuity along an outer edge of each area of discontinuity exceeds a predetermined threshold;

replacing areas of actual occlusion in the seed image with corresponding non-occluded areas from one of the other images in the set to form a composite image from the seed image.

13 (Original). The system of claim 12 wherein the system is embedded in a digital camera.

14 (Original). The system of claim 12 wherein aligning each of the images to the base images comprises applying a geometric transform to each image relative to the base image for registering each of the images to the base image.

15 (Original). The system of claim 14 further comprising individually cropping each image so that all images cover approximately the same view of the scene.

16 (Original). The system of claim 12 further comprising balancing the images by applying any of histogram averaging of the images based on corresponding targets for each image, and white balancing of the images based on corresponding targets for each image.

17 (Original). The system of claim 12 wherein identifying areas of potential occlusion in each of the aligned images further comprises dividing each image in the set of images into a number of pixel blocks, and comparing corresponding pixel blocks between each image to determine whether the corresponding blocks match within a predetermined threshold.

18 (Original). The system of claim 12 wherein identifying areas of potential occlusion in each of the aligned images further comprises a pixel-by-pixel comparison of corresponding pixels between each image to determine whether the corresponding pixels match within a predetermined threshold.

19 (Original). The system of claim 12 wherein identifying areas of potential occlusion in each of the aligned images further comprises automatically constructing an image mask for identifying all regions of potential occlusion in the set of images.

20 (Original). The system of claim 12 wherein replacing areas of actual occlusion in the seed image with corresponding non-occluded areas from one of the other images in the set further comprises at least one of blending, feathering, and pixel averaging an outer edge of the corresponding non-occluded areas with respect to the seed image.

21 (Original). A computer-implemented process for removing occlusions from a mosaic image created from a set of images of a scene, comprising:

inputting a set of two or more images of a scene;

aligning each of the images to a base image selected from the set of images;

comparing each of the aligned images to identify areas of potential occlusion in each of the aligned images;

determining a level of discontinuity along an outer edge of each area of potential occlusion for each image, said level of discontinuity indicating an area of actual occlusion where the level of discontinuity exceeds a predetermined discontinuity threshold, and said level of discontinuity indicating an area of non-occlusion where the level of discontinuity is less than the predetermined discontinuity threshold;

creating an image mask for each image, said image masks indicating areas of occlusion and areas of non-occlusion for each image; and

using the image mask for each image for creating a mosaic image by replacing areas of actual occlusion in one of the images with corresponding areas of non-occlusion from one of the other images.

22 (Original). The computer-implemented process of claim 21 wherein the computer is integral to a digital camera, and wherein the composite image is formed automatically from images of a scene captured using the digital camera.

23 (Original). The computer-implemented process of claim 21 wherein replacing areas of actual occlusion in one of the images with corresponding areas of non-occlusion from one of the other images further comprises blending pixels along an outer edge of the corresponding areas of non-occlusion with pixels surrounding the areas of actual occlusion being replaced.

24 (Original). The computer-implemented process of claim 21 wherein replacing areas of actual occlusion in one of the images with corresponding areas of non-occlusion from one of the other images further comprises feathering pixels along an outer edge of the corresponding areas of non-occlusion with pixels surrounding the areas of actual occlusion being replaced.

25 (Original). The computer-implemented process of claim 21 wherein replacing areas of actual occlusion in one of the images with corresponding areas of non-occlusion from one of the other images further comprises averaging pixels along an outer edge of the corresponding areas of non-occlusion with pixels surrounding the areas of actual occlusion being replaced.

26 (Original). The computer-implemented process of claim 21 further comprising balancing the set of images after registering the set of images.

27 (Original). The computer-implemented process of claim 26 wherein balancing the images comprises histogram averaging of the images based on corresponding targets for each image.

28 (Original). The computer-implemented process of claim 26 wherein balancing the images comprises white balancing the images based on corresponding targets for each image.

IX. EVIDENCE APPENDIX

None

X. RELATED PROCEEDINGS APPENDIX

None

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